

$\ln a^3$   $\left\{ \begin{array}{l} \text{opti} \\ \text{pass} \end{array} \right.$

To reduce losses as a result of the light pipe transmission, there is a lens formed to collimate light between the transducer end of the light pipe and the optical transducer. The collimating lenses are formed in the light pipe. There are also provided additional lenses on the optical data port side of the light pipe. Transmitted light from the light pipe passes through a lens that increases the illumination angle of the light exiting from the optical data port. Received light passes through a lens that amplifies and collimates the light into the receiving light pipe.